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APPARATUS AND METHOD FOR PRODUCING A POLYOLEFINIC TRANSPIRING FILM

Field of Invention

The present invention relates to an apparatus and method for producing a polyolefinic transpiring
(semipermeable) film, capable of allowing vapour and air to pass therethrough while being impermeable to liquids.

The Prior Art

The patent EP 0.283.200 B1, to which reference is made for a general ^{understanding} view of the prior art, describes a method for producing transpiring films in which ^{an extruded low density} a linear polyethylene ~~extrusion at~~ low density (LLDPE), ^{containing} charged with CaCO_3 , is first heat-embossed, ^{to provide} for providing reduced thickness imprints, and then stretched to obtain a transpiring film with a particularly elevated transpirability in the reduced thickness zones.

Transpiring films according to the prior art ~~moreover~~ have various problems and drawbacks.

One problem which is encountered in known polyolefinic transpiring films is the possible formation of micro-holes during the stretching ~~phase~~ of the film, which formation is due to the presence of impurities, in particular oxidised and carbonised particles.

Such impurities may already be present in the mix to be extruded, or they may form during the extrusion ~~process~~ of the polyethylene.

The micro-holes, which have an average diameter between 0.2 and 2 mm, may compromise the liquid impermeability characteristics; ^{which} such risk increases with the speed of the stretching process and with ~~the~~ increase in the degree of stretching of the film.

Another problem which is encountered in polyolefinic transpiring films is the non-uniformity of the transpirability.

Accordingly, ^{objective} ~~aim~~ principle ^{aim} of the present invention is to provide a method and an apparatus for producing a polyolefinic transpiring film which ~~allows to~~ overcome at least part of the above cited problems.

~~Such aim is obtained by means of a method in accordance with the claim 1 and by means of a plant in accordance with claim 4.~~

(insert from claims)

SUMMARY OF THE INVENTION

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a polyolefin

which allows vapour and air to pass therethrough, while being impermeable to liquids, the method

CLAIMS

Accordingly, the present invention provides a method

1. Method for producing polyolefinic transpiring films comprising the steps of:

- 1. bubble extruding a mix of charged LLDPE; *double layer having two layers*
- 2. flattening the tubular (10) in order to obtain a flat film (11); *double layer*
- 3. heating the flat film (11) up to a softening temperature; *its*
- 4. compressing the flat film (11); *double layer* to unite the layers of the double layer flat film
- 5. cooling the flat film to a temperature between 8-30 °C; and *double layer*
- 6. transversely and/or longitudinal stretching of the flat film (11); *double layer* to impart transpirability

2. Method, according to claim 1, wherein the flat film (11) is first heated by conduction and then successively by irradiation.

3. Plant for producing a stretched polyolefinic film comprising, in succession:

- 1. a bubble extruder (1); *double*
- 2. a first calender (2) adapted to flatten the extruded tubular; *for flattening tube to form a double layer flat film having two layers*
- 3. means (3,4) adapted to heat the flat film (11) up to a softening temperature; *heating for its*
- 4. a second calender (5) adapted to compress the heated film; *for its double layer flat to unite the two layers*
- 5. means (5) adapted to quickly cool the film up to a temperature comprised between 8-30 °C; and *cooling for its double layer flat*
- 6. means (6) adapted to transversely stretch the film and/or means (8) adapted to longitudinally stretch the film; *stretching for transversely its to form double layer flat*

4. Plant, according to claim 3, wherein said means adapted to heat the flat film (11)

comprise, in succession:

The heating means may include

- first heating means, adapted to heat the film by conduction; and
- second heating means adapted to heat the film by irradiation.

Further embodiments of the method may be carried out in accordance with the dependent claims

BRIEF DESCRIPTION OF THE DRAWING

The sole drawing, Figure 1, is a schematic view illustrating apparatus 2 and 3, and further embodiments of the plant may be carried out in accordance with the utilized in practice of the method of the present invention.

dependent claims 5 and 6.

DESCRIPTION OF PREFERRED EMBODIMENTS

The method and the apparatus according to the invention will appear in a clear manner from the

5 following description of one possible embodiment, provided in a purely indicative manner, together with the drawing figure which shows, in a schematic view, a manufacturing plant in accordance with the invention.

The present method provides for the use of a mix preferably of linear polyethylene at low density (LLDPE) charged with a base of CaCO_3 .

10 Alternatively, it is possible to use linear polyethylene at low density (LLDPE) or polyethylene at medium density (MDPE).

It is also possible to use copolymers of polyethylene having α -olefin with 4-10 atoms of carbon (1-hexene, 1-heptene, 1-octene, 1-butene, 1-pentene, 1-octene, 1-octene, 4-methyl, 1-pentene).

Naturally, it is also possible to use other types of charges, organic or inorganic, having

15 dimensions between 0.6 and 6 μm and treated in a way to render their surfaces hydrophobic.

In particular, it is possible to use: clay, kaolin, zeolite, Zn, Al, Ca, CaSO_4 , BaSO_4 , MgO ,

Mg(OH)_2 , TiO_2 .

The quantity (charge) of filler. The quality of the added charge depends also on the degree of desired transpirability. Normally the filler charge constitutes from 30% to 70% by weight of the mix.

Such mix is bubble-extruded (so-called blow moulding), by means of a circular-head extruder 1 in order to obtain a tubular 10.

The temperature of the tubular exiting from the extruder 1 is between 150-230°C and, preferably, between 170-190°C.

The ratio of expansion of the tubular 10 may vary between 1:2 and 1:4, and preferably is 1:3.

One characteristic of the method of the present invention is the fact that the extruded and expanded tubular 10 is subjected to a calendering operation.

In detail, the ^{tube} ~~tubular~~ 10 enters, at a temperature of about 80-100°C, ~~in~~ ^{of} a first calender 2 where it is compressed and stretched into the form of a sheet 11 ~~constituted by~~ ^{of} two superimposed layers, assuming a width equal to half of the circumference of the ~~tubular~~ ^{tube} and a thickness which is double ~~with respect to~~ ^{tube} the thickness of the ~~tubular~~.

No ④ → Such ^{a process} ~~characteristic~~ has the advantage of resolving the problem of insufficient liquid impermeability due to the micro-holes which may form in the films during the stretching ~~phase~~ ^{because} it is ~~in fact~~ ^{will be} extremely improbable that both the layers of the film ~~are~~ damaged at the same point.

The calender 2 used for flattening the ^{tube} ~~tubular~~ 10 comprises a pair of smooth coupled rollers of which the first one is chromed steel and the second one is rubber with a hardness of 60-80 shore. The pressure supplied by the calender 2 on the flattened ^{tube} ~~tubular~~ 10 varies between 5 and 10 kg/cm².

⑦ A second characteristic of the method according to the invention ~~consists in the fact~~ ^{is} that after having been flattened, the film 11 is heated ~~up to~~ ^{its} a softening temperature.

Such temperature depends on the type of mix which is extruded, in the case of an LLDPE base mix it may vary between 80 and 130 °C and usually, it is around about 100 °C.

one ⑧ The heating executed in this manner favours the removal of ~~humidity or~~ ^{moisture and} additives present in the mix which have a low evaporation point.

Moreover, the heating executed in this manner favours the elimination of micro-stresses present in the film due to the preceding ^{steps} ~~phases~~ of the method and favours ~~the~~ ³ homogenization of the internal structure of the film.

one ⑨ ^{For} In order to obtain the heating, the film 11 is first ~~made to~~ run on heated rollers 3, having a temperature of about 60-70 °C, and then ~~made to~~ ^{ed} pass near infrared ray lamps 4 which further increase the temperature up to the ~~point of~~ ^{point} softening.

one ⑩ In fact the use ~~only of the~~ ^{the film} heated rollers - normally heated with water or oil - does not allow to reach ~~the~~ ^{its} softening temperature, or at least ~~with~~ ^{not without} great difficulty.

Moreover, ^{a/50} the infrared lamps provide the advantage of ~~also~~ strongly heating the layer of air about the film 11 (typically up to 300-400 °C) which ~~therefore permits to~~ completely eliminate ⁵ the residual humidity still present on the film 11.

7 A third characteristic of the method according to the invention consists in the fact that the film ⁵ heated in this manner is further ^e calendered by a calender 5 and, thereafter, cooled to a temperature between 8 and 30 °C.

Such cooling is carried out, preferably, through contact ^{with} ~~by means of~~ one of the rollers of the calender 5, which is maintained at a constant temperature between 8 and 30 °C.

The further calendering ~~permits~~, through the compression provided by the rollers, ^{to} intimately ¹⁰ unite the two original layers so as to avoid the risks of de-lamination of the film produced in this manner, and the thermal shock to which the film is subjected ^{stops} ~~permits to block~~ the stabilization ² process.

It is also possible, in this phase, to ~~carry out an embossing operation of~~ the film for a purely aesthetic purpose which does not modify the weight of the film.

15 It has been found that the thermal shock to which the film is subjected ^{provides} ~~allows to obtain an~~ improved transpirability during the successive stretching operations.

The compression of the film is obtained by coupling a chromed-steel roller ~~coupled~~ with a rubber roller (hardness 60-80 shore).

After ² Successively to the process of sterilization, the film 11 is subjected to transverse and/or longitudinal stretching.

For such purpose, ^{the method employs} ~~there are present~~ appropriate means 6 adapted to carry out the transverse ^e stretching and appropriate means 8 adapted to carry out the longitudinal stretching.

In the illustrated example, the film 11 is subjected first to a transverse ⁵ stretching and then to a longitudinal stretching. ^{stretchings} ~~naturally these phases may also be~~ ^{reversed} ~~inverted~~.

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Preferably between the transversal stretching means 6 and the longitudinal stretching means 8 there are provided tentering means 7 for eliminating the folds created by the first process of stretching.

Normally, the ratio of longitudinal stretching varies between 1:1.5 and 1:2.5.

Also in this manner, the ratio of longitudinal stretching varies, usually, between 1:1.5 and 1:2.5.

However, if required, the ratio of stretching may ^{be up to} ~~also arrive to a ratio of~~ 1:4.

At the end of the stretching ~~phase~~, the film 11 may undergo further working steps or be wound up by an appropriate winding machine 9.

ABSTRACT

The invention relates to a method and a plant for producing polyolefinic transpiring films by means of bubble extrusion of a ^{and filler} charged LLDPE mix, flattening of the extruded ^{tube} tubular ~~in order~~ ^{double layer} to obtain a flat film and transverse ^{self} and/or longitudinal ^{ly} stretching of the flat film. ^{double layer}

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